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PARASITOIDS ASSOCIATED WITH THE MACROLEPIDOPTERA COMMUNITY AT COOPER'S ROCK STATE FOREST, WEST VIRGINIA: A BASELINE STUDY[1]

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Abstract.—During 1984 and 1985 macrolepidopterous larvae were collected by means of pole pruning from foliage of black birch, mixed oaks, black cherry, and red maple at Cooper's Rock State Forest in northern West Virginia. From 46 species of caterpillars, 74 species of parasitoids in eight families were reared. The most abundant parasitoids were Tachinidae (Diptera): *Hyphantrophaga virilis* (Aldrich and Webber) and *Compsilura concinnata* (Meigen); Braconidae (Hymenoptera): *Protapanteles paleacritae* (Riley), *Microplitis hyphantriae* (Ash.), and *Diolcogaster facetosa* (Weed); Eulophidae (Hymenoptera): *Euplectrus maculiventris* (Westwood), *Eulophus anomocerus* (Crawford), and *E. nebulosus* (Prov.); and Perilampidae (Hymenoptera): *Perilampus canadenis* (Crawford).

Key Words: Parasitoids, macrolepidoptera community, baseline study

In 1984 and 1985, Cooper's Rock State Forest in northern West Virginia was just west of the leading edge of the infestation of the gypsy moth, *Lymantria dispar* (L.) (Lepidoptera: Lymantriidae). During those two years, a study was conducted to obtain baseline data for native lepidopterous defoliators and their parasitoids before the buildup of gypsy moth and subsequent defoliation and suppression efforts.

Previous reports have summarized hymenopterous and dipterous parasitoids associated with macrolepidopterous larvae (Muesebeck et al. 1951, Krombein and Burks 1967, Krombein 1958, Krombein et al. 1979, Viereck 1916, Arnaud 1978, Raizenne 1952, Schaffner and Griswold 1934, Townes and Townes 1959, 1960, 1962). Butler (1990) recorded 28 species of parasitoids associated with a "looper" complex in eastern West Virginia.

During the baseline study at Cooper's Rock State Forest, 400 species of adult macrolepidoptera were collected by blacklight trap (Butler and Kondo 1991) and 100 species of macrolepidopterous larvae were collected from the most abundant host trees (Butler 1992). Here I report results of the associated study of parasitoids reared from macrolepidoptera larvae.

METHODS AND MATERIALS

The West Virginia University Forest at Cooper's Rock State Forest is located at 561 m in Preston and Monongalia counties about 32 km east of Morgantown, West Virginia. The area consists of a 50- to 60-year-old mixed mesophytic forest (Carvell 1983). The most abundant tree species in the study area are red maple (*Acer rubrum* L., Aceraceae), white and red oak (*Quercus alba* L., *O. rubra* L., Fagaceae), black cherry (*Prunus serotina*

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Ehrh., Rosaceae), and black birch (*Betula lenta* L., Betulaceae).

Macrolepidopterous larvae were sampled from the mid- and lower canopies of red maple, mixed oaks, black cherry and black birch using pole pruners with large plastic catch bags. Samples were taken once each week from 16 May to 11 October 1984 and from 2 May to 3 October 1985.

In the laboratory, macrolepidopterous larvae were removed from the foliage, identified and placed for rearing in 150 × 25 ml plastic Petri dishes on bouquets of fresh foliage of the appropriate host plant. At pupation, Lepidoptera were placed in jars of moist vermiculite and held at 24° C or, for those species requiring a cold period, jars were held at 4° C for a minimum of 90 days. As parasitoid larvae emerged and pupated, they were placed in 4 dram vials of moist vermiculite plugged with cotton. Adults emerging from pupation vials or directly from macrolepidopterous larvae or pupae were killed, pinned, labeled and sent to specialists for identification. Voucher specimens are located in the West Virginia University Arthropod Collection.

Results

Parasitoids were reared from 46 Macrolepidoptera species (Table 1). A total of 74 parasitoid species in eight families was recorded. The number of parasitoid species in each family is as follows: 11 Tachinidae, 29 Ichneumonidae, 16 Braconidae, 1 Trigonalidae, 1 Chalcididae, 13 Eulophidae, 1 Pteromalidae and 2 Perilampidae.

Species reared most frequently from four or more different host species include Tachinidae *Hyphantrophaga virilis* (8 hosts) and *Compsilura concinnata* (7 hosts); Braconidae *Protapanteles paleacritae* (7 hosts), *Diolcogaster facetosa* (4 hosts), and *Microplitis hypantriae* (4 hosts); Eulophidae *Eulophus anomocerus* (5 hosts), *E. nebulosus* (5 hosts), and *Euplectrus maculiventris* (4 hosts); and Perilampidae *Perilampus canadensis* (4 hosts). No attempt was made to determine percentage parasitism contributed by each parasitoid species.

Discussion

The liklihood of rearing multiple species of parasitoids from a given lepidopterous larval species increases as abundance of the larva increases. The two most abundant species of caterpillars collected at Cooper's Rock State Forest in 1984 and 1985 were the noctuids *Polia latex* (Gn.) and *Morrisonia confusa* (Hbn.) (Butler 1992); 16 and 14 species of parasitoids were reared from these two species, respectively. Other abundant species of caterpillars were the geometrids *Itame pustularia* (Gn.) (9 species of parasitoids), *Lomographa vestaliata* (Gn.) (7), *Campaea perlata* (Gn.) (7); the arctiids *Hyphantria cunea* (Drury) (7), and *Halysidota tesselaris* (J. E. Smith) (6); and *Acronicta fragilis* (Gn.) (5) and *A. ovata* (Grt.) (5). The geometrids *Melanolophia canadaria* (Gn.) and *Probole amicaria* (H.-S.) were among the most numerous caterpillars, but only four and three species of parasitoids were reared from them, respectively.

During a study of parasitoids associated with an outbreak of a looper complex (Geometridae) in eastern West Virginia in 1983 and 1984, Butler (1990) reared 21 species of parasitoids from *Phigalia titea* (Cram.), the most abundant of the looper species.

Twenty-one of the 136 primary parasitoid/host relationships listed in Table 1, reconfirm records published by Arnaud (1978) for Tachinidae and by Krombein et al. (1979) for hymenopterous taxa. These previous records are, as expected, for lepidopterous hosts which are generally more abundant and/or considered more economically important: *Alsophila pometaria, Erannis tiliaria, Hydria prunivorata, Malacosoma americanum, Dryocampa rubicunda, Anisota virginiensis, Nadata gibbosa, Hyphantria cunea,* and *Orygia leucostigma.* New primary parasitoid/host records presented here total 115 or 85% of those generated during this study.

Table 1. Parasitoid taxa reared from Macrolepidoptera larvae collected at Cooper's Rock State Forest 1984 and 1985. Secondary parasitoids indicated by "2°."

Macrolepidoptera Species N[1]	Parasitoids Family[2]	Genus/Species[3]
Drepanidae		
Drepana arcuata Wlk. 2	Brac.	*Rogas* sp. R
Geometridae		
Alsophila pometaria (Harr.) 9	Brac.	*Protapanteles paleacritae* (Riley) R
Itame pustularia (Gn.) 234	Tach.	*Hyphantrophaga virilis* (Aldrich & Webber) U
		Xanthophyto sp. U
		Blepharomyia sp. U
	Ichn.	*Drusonia deceptor* (Walley) U
		Casinaria forcipata Walley U
	Brac.	*Meteorus* sp. U
		Rogas sp. U
	Chal.	*Brachymeria aeca* Burks (2°)
	Eulo.	*Euplectrus maculiventris* Westwood U
Glena cribrataria (Gn.) 5	Brac.	*Rogas* sp. U
Epimecis hortaria (F.) 2	Brac.	*Cotesia* sp. U
Melanolophia canadaria (Gn.) 228	Tach.	*Xanthophyto* sp. U
	Ichn.	*Aphanistes* sp. U
	Brac.	*Protapanteles paleacritae* (Riley) U
		Cotesia sp. U
Hypagyrtis unipunctata (Haw.) 11	Pter.	*Hypopteromalus tabacum* (Fitch) U
Erannis tiliaria (Harr.) 40	Ichn.	*Hyposoter fuscitarsis* (Vier.) R
		Phobocampe geometrae (Ash.) R
Lomographa vestaliata (Gn.) 123	Tach.	*Compsilura concinnata* (Meigen) U
		Hyphantrophaga virilis (Aldrich & Webber) U
	Ichn.	*Aphanistes heinrichi* Hopper U
		Mesochorus pictilis Holmgren (2°)
	Brac.	*Protapanteles paleacritae* (Riley) U
		Meteorus sp. U
		Rogas sp. U
Lomographa glomeraria (Grt.) 183	Tach.	*Compsilura concinnata* (Meigen) U
		Hyphantrophaga virilis (Aldrich & Webber) U
	Brac.	*Diolcogaster facetosa* (Weed) U
		Meteorus sp. U
Campaea perlata (Gn.) 59	Brac.	*Protapanteles paleacritae* (Riley) U
		Diolcogaster facetosa (Weed) U
		Microgaster sp. U
	Eulo.	*Euplectrus maculiventris* Westwood U
		Cirrospilus cinctithorax (Girault) U
		C. sp. 2 U
	Peri.	*Perilampus canadensis* Crawford (2°)
Probole amicaria (H.-S.) 237	Ichn.	*Mesochorus discitergus* (Say) U
	Brac.	*Protapanteles paleacritae* (Riley) U
		Cotesia sp. U
Plagodis serinaria (H.-S.) 10	Tach.	*Hyphantrophaga virilis* (Aldrich & Webber) U
		Xanthophyto sp. U
	Ichn.	*Platylabus hyperetis* Heinr. U
Besma endropiaria (G. & R.) 18	Tach.	*Hyphantrophaga virilis* Aldrich & Webber) U
Nemoria mimosaria (Gn.) 4	Brac.	*Protapanteles paleacritae* (Riley) U
Hydria prunivorata (Fgn.) 139	Ichn.	*Sinophorus hydriae* Sanborne U
	Brac.	*Cotesia acauda* (Prov.) R

Table 1. Continued.

Macrolepidoptera Species N[1]	Parasitoids Family[2]	Genus/Species[3]
Lasiocampidae		
Malacosoma americanum (F.) 6	Tach.	*Compsilura concinnata* (Meigen) R
		Lespesia sp. R
	Ichn.	*Bathythrix triangularis* (Cresson) (2°)
Saturniidae		
Dryocampa rubicunda (F.) 42	Tach.	*Eumasicera sternalis* (Coquillett) R
		Lespesia anisotae (Webber) U
	Ichn.	*Hyposoter fugitivus* (Say) R
Anisota virginiensis (Drury) 71	Ichn.	*Hyposoter fugitivus* (Say) R
	Trig.	*Poecilogonalos costalis* (Cresson) U
Notodontidae		
Nadata gibbosa (J.E. Smith) 37	Tach.	*Compsilura concinnata* (Meigen) R
Symmerista leucitys Franc. 46	Ichn.	*Ophion flavidus* Brullé U
Macrurocampa marthesia (Cram.) 46	Tach.	*Lespesia stonei* Sabrosky U
	Trig.	*Poecilogonalos costalis* (Cresson) U
Heterocampa guttivitta (Wlk.) 23	Eulo.	*Eulophus* sp. near *koebelei* (Crawford) U
Lochmaeus manteo Doubleday 21	Tach.	*Lespesia stonei* Sabrosky U
	Brac.	*Diolcogaster schizurae* (Mues.) U
Schizura unicornis (J.E. Smith) 4	Brac.	*Diolcogaster schizurae* (Mues.) U
Arctiidae		
Hyphantria cunea (Drury) 73	Tach.	*Compsilura concinnata* (Meigen) R
		Hyphantrophaga blanda (Osten Sacken) U
		Blondelia hyphantriae (Tothill) R
	Ichn.	*Therion sassacus* (Vier.) R
	Brac.	*Cotesia hyphantriae* (Riley) R
		Meteorus hyphantriae (Riley) R
	Eulo.	*Elachertus cidariae* (Ash.) U
Halysidota tessellaris (J.E. Smith) 63	Tach.	*Blondelia hyphantriae* (Tothill) R
	Ichn.	*Therion morio* (F.) U
		Bathythrix triangularis (Cresson) (2°)
		Mesochorus discitergus (Say) (2°)
	Brac.	*Cotesia phoberti* (Rohwer) R
	Peri.	*Perilampus canadensis* (Crawford) U
Lymantriidae		
Orygia leucostigma (J.E. Smith) 38	Ichn.	*Phobocampe pallipes* (Prov.) R
		Iseropus stercorator orygiae (Ash.) R
	Brac.	*Meteorus tersus* (Mues.) U
	Peri.	*Perilampus hyalinus* (Say) (2°)
Noctuidae		
Bomolocha baltimoralis (Gn.) 35	Tach.	*Oswaldia assimilis* (Townsend) U
	Ichn.	*Hyposoter annulipes* (Cresson) U
	Brac.	*Protapanteles paleacritae* (Riley) U
Zale minerea (Gn.) 19	Tach.	*Xanthophyto* sp. Townsend U
	Brac.	*Distatrix* sp. U
Parallelia bistriaris Hbn. 46	Ichn.	*Netelia palpalis* (Cush.) U
		Netelia sp. U
	Brac.	*Rogas* sp. U
Cerma cerintha (Tr.) 7	Tach.	*Compsilura concinnata* (Meigen) U
Colocasia propinquilinea (Grt.) 13	Brac.	*Microplitis* sp. U

Table 1. Continued.

Macrolepidoptera Species N[1]	Parasitoids Family[2]	Parasitoids Genus/Species[3]
Acronicta americana (Harr.) 19	Brac.	*Diolcogaster* (poss. *facetosa*) (Weed) U
Acronicta hasta (Gn.) 14	Tach.	*Hyphantrophaga virilis* (Aldrich & Webber) U
	Brac.	*Rogas* sp. U
Acronicta fragilis (Gn.) 124	Tach.	*Compsilura concinnata* (Meigen) R
	Brac.	*Meteorus hyphantriae* (Riley) U
		Meteorus communis (Cresson) U
		Meteorus sp. U
		Rogas sp. U
Acronicta ovata (Grt.) 106	Ichn.	*Phobocampe* n. sp. U
	Brac.	*Meteorus hyphantriae* (Riley) U
		Meteorus sp. U
	Eulo.	*Eulophus anomocerus* (Crawford) U
		Eulophus sp. U
Amphipyra pyramidoides (Gn.) 6	Brac.	*Microplitis hyphantriae* Ash. U
Lithophane hemina (Grt.) 23	Ichn.	*Diphyus comes* (Cresson) U
	Eulo.	*Eulophus anomocerus* (Crawford) U
		Eulophus nebulosus (Prov.) U
Eupsila morrisoni (Grt.) 9	Brac.	*Microplitis hyphantriae* Ash. U
Polia latex (Gn.) 276	Tach.	*Hyphantrophaga virilis* (Aldrich & Webber) U
		Blondelia hyphantriae (Tothill) U
		Lespesia stonei Sabrosky U
	Ichn.	*Hyposoter fugitivus* ((Say) U
		Alloplasta superba (Prov.) U
		Eutanyacra improvisa (Cresson)
		Mesochorus pictilis Holmgren (2°)
	Brac.	*Diolcogaster facetosa* (Weed) U
		Microplitis hyphantriae Ash.
		Microplitis sp. U
		Meteorus bakeri C. & D. U
	Eulo.	*Euplectrus maculiventris* Westwood U
		Euplectrus sp. U
		Eulophus nebulosus (Prov.) U
		Eulophus sp. U
	Peri.	*Perilampus canadensis* Crawford (2°)
Orthosia rubescens (Wlk.) 6	Eulo.	*Eulophus nebulosus* (Prov.) U
		Eulophus smerinthi (Ash.) U
		Eulophus anomocerus (Crawford) U
Orthosia hibisci (Gn.) 14	Eulo.	*Eulophus nebulosus* (Prov.) U
		Eulophus anomocerus (Crawford) U
Crocigrapha normani (Grt.) 6	Eulo.	*Eulophus nebulosus* (Prov.) U
		Eulophus anomocerus (Crawford) U
Morrisonia confusa (Hbn.) 263	Tach.	*Hyphantrophaga virilis* (Aldrich & Webber) U
	Ichn.	*Hyposoter annulipes* (Cresson) U
		Drusonia wyomingensis (Vier.) U
		Enicospilus merdarius (Grav.) U
		Isodromas lycaenae How. U
		Mesochorus vittator (Zett.) U
		Itoplectis conquisitor (Say) (2°)
	Brac.	*Microplitis hyphantriae* Ash. U
		Microplitis sp. U
		Cotesia sp. U

Table 1. Continued.

Macrolepidoptera Species N[1]	Parasitoids	
	Family[2]	Genus Species[3]
	Eulo.	*Euplectrus maculiventris* Westwood U
		Euplectrus bicolor (Swederus) U
		Pediobius crassicornis (Thomson) U
	Peri.	*Perilampus canadensis* Crawford (2°)
Abagrotis alternata (Grt.) 15	Eulo.	*Euplectrus bicolor* (Swederus) U

[1] Number of specimens reared of each macrolepidoptera species.
[2] Tach. = Tachinidae; Ichn. = Ichneumonidae; Brac. = Braconidae; Trig. = Trigonalidae; Chal. = Chalcididae; Eulo. = Eulophidae; Pter. = Pteromalidae; Peri. = Perilampidae.
[3] R = parasitoid/host relationships recorded by Arnaud (1978) for Tachinidae (Diptera) and Krombein et al. (1979) for hymenopterous species. U = those parasitoid host relationships not recorded in above publications. Secondary parasitoids not considered.

At Cooper's Rock in 1984 and 1985 little defoliation was evident from the 100 species of macrolepidopterous larvae collected on black cherry, black birch, red maple, and mixed oaks. Caterpillar populations were generally low. Among the factors responsible for the low populations were the 74 species of parasitoids obtained in this study. Our knowledge of parasitoid/host relationships for most of our native forest defoliating macrolepidoptera is apparently very limited as evidenced by the large number of new records in this study.

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